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### PAPERS OF 1874.

#### THE UTILITY OF GOVERNMENT GEOLOGICAL SURVEYS.

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[Re-printed from the Penn Monthly for March, 1874.]

#### PAPERS READ BEFORE THE ASSOCIATION.

The following is a list of the Papers read before the Association :

1871. *Compulsory Education.* By Lorin Blodget.  
*Arbitration as a Remedy for Strikes.* By Eckley B. Coxe.  
*The Revised Statutes of Pennsylvania.* By R. C. McMurtrie.  
*Local Taxation.* By Thomas Cochran.  
*Infant Mortality.* By Dr. J. S. Parry.
1872. *Statute Law and Common Law, and the Proposed Revision in Pennsylvania.* By E. Spencer Miller.  
*Apprenticeship.* By James S. Whitney.  
*The Proposed Amendments to the Constitution of Pennsylvania.* By Francis Jordan.  
*Vaccination.* By Dr. J. S. Parry.  
*The Census.* By Lorin Blodget.
1873. *The Tax System of Pennsylvania.* By Cyrus Elder.  
*The Work of the Constitutional Convention.* By A. Sydney Biddle.  
*What shall Philadelphia do with its Paupers?* By Dr. Ray.  
*Proportional Representation.* By S. Dana Horton.  
*Statistics Relating to the Births, Deaths, Marriages, etc., in Philadelphia.* By John Stockton-Hough, M. D.  
*On the Value of Original Scientific Research.* By W. S. W. Ruschenberger.  
*On the Relative Influence of City and Country Life, on Morality, Health, Fecundity, Longevity and Mortality.* By John Stockton-Hough, M. D.
1874. *The Public School System of Philadelphia.* By a member of the Board of Education.  
*The Utility of Government Geological Surveys.* By J. P. Lesley.

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## THE UTILITY OF GOVERNMENT GEOLOGICAL SURVEYS.

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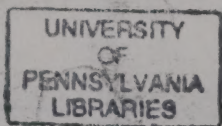
THE origin of geological surveys must be sought in the curiosity of mankind respecting the planet on which he rides, as on a chariot, through time and space. Men have desired to gaze with the eyes of their imagination at the round earth, as they have been gazing for thousands of years with untired wonder and pleasure at the moon. How splendid, how quaint an object would the world we live on look to an inhabitant of the moon? Artificial globes enable us to create this object. They are but the ripe fruit of the leafy tree of geography. To dissect this fruit and study its tissues, count its veins, trace its circulating fluids, develop the history of its past life, and learn the practical value of its material elements—*that* is to make a geological survey.

The curiosity of man once awakened, his artistic powers are set at exercise; then his understanding sits in judgment upon his work of art; his necessities push his inventive talents into all the fields of labor; and civilization is the product of the whole. Civilization! That means a nation observing truly, thinking judiciously, laboring economically, and living in peace and plenty.

I place the power of observation first. It gives the beginnings of useful knowledge, the means of progress toward a perfect state of society.

The curious but uncertain inquiries of the ancient geographers resulted in a mass of almost useless myths, a world of silly anecdotes. It was the boy-play of science.

The precise and exhaustive study bestowed by modern geologists is concentrating, consolidating, defining and completing for man a perfect idea of his large and copious ancestral estate, on which and by which he lives with a splendor of comfort, with resources of action, and with anticipations of a future, not to be thought of by Plato, Aristotle and Herodotus.



Why should I stand before you to-night to justify this modern manly mode of treating things? It justifies itself. It has come about in the regular course of ages. It is the destined progress of human society. It is the seal of civilization. It makes the common man of the nineteenth century equal to the princes of the world. It has carried the western nations to a pitch of wealth and power from which they look out over the sleeping East with pitying contempt. It has filled Europe and America with cities more splendid and powerful than Thebes, Babylon, Antioch, and Rome ever could have made themselves. It has covered continents with railroads dug out of a thousand mines; strewed the oceans with iron steamers born of blast furnaces as high as old baronial towers. It lights the homes of Europe with an annual export of 5,000,000 barrels of oil sucked from the rocks a thousand feet below the river beds of Pennsylvania; and it gathers to the foci of the printing press the daily news of what is happening over the surface of the globe.

Do you object, that I am speaking of science as a whole, and not of geology—and not of one application of geology, viz.: to surveys instituted and effected by government?

I answer, that the glory of the modern times is this: that a status of war has been replaced by a status of peace; and accurate distributed science has done it. Governments are now democracies, and the good of all is regarded, instead of the greed and ambition of a few. Governments are now bosses in a workshop. A government undertakes that which individuals cannot accomplish. Formerly, some Herodotus, some Agathodemon, some Pytheas of Marseilles must travel alone, unaided, unprotected, to work out in an unsystematic and dissolute-wise the geography of unknown lands, with the result of merely keeping alive the flame of learning in the hearts of his few scattered and helpless compeers. Now, governments organize geographical expeditions and geological surveys, with immense resources and the finest apparatus for discovery, investigation and publication; entrust the work to corps of thorough-bred experts; continue it for an indefinite number of years, and are not satisfied until they make it known in its complete shape to all other governments and the people of christendom.

Thus was prepared that fine topographical map of Switzerland,

under the direction of General Dufour; and the great geological map of France, under the direction of Elie de Beaumont. Sweden is publishing annually the sheets of its geological survey as fast as they are completed. Holland has for years been doing the same. Great Britain has had four geological surveys in progress in the last forty years—one for England, one for Scotland, one for Ireland and one for India. Already a little library of their volumes and atlases stands on the shelves of all the learned societies of the world; and reductions of the work, published for the use of miners, civil engineers, travelers, and capitalists, may be bought cheaply at any English book-store.

Besides all this, the government of Great Britain has had for many years an ordnance survey at work, mapping the British land; and her hydrographic charts are used by the marine service of all commercial nations.

Even Italy has her geological commissioners, with their central office in Florence, regularly publishing the results of their surveys of the peninsula.

Bavaria has its geological survey. Russia has its geological survey. Austria has had on foot for a long time the grandest geological survey which the world has as yet seen, not excepting that of Great Britain. The maps of the provinces of Austria, colored geologically, would cover one of the walls of this room, and the reports of the special geology of the different districts already studied are of unsurpassed excellence. Nor does there seem to be any relaxation of this noble ambition of regenerated Austria to portray, with all the perfection attainable by modern means, the surface features, the underground wealth, and the practical machinery of her national possessions.

There was a time, forty years ago, when the United States of America seemed fired by a like spirit of wise economical inquiry. Geological surveys were established by Massachusetts, Connecticut, New Hampshire, Vermont, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, South Carolina, Alabama and Ohio; followed in subsequent years by Maine, Vermont, North Carolina, Kentucky, Tennessee, Mississippi, Arkansas, Missouri, Illinois, Wisconsin, Iowa, and lastly by Indiana and Texas.

But how utterly ignorant were the legislatures of the States thus

named, *then*, of the proper way, the actual cost and the immense value of the work they ordered to be done! How few and how ill prepared were the workers! How vast the fields they were set to till. Most of these States, empires in point of territory, were to be surveyed by one geologist, authorized to employ one or two assistants. No provision was made for the future. No hope was given to the State geologist that he would be kept employed. No sufficient funds were placed at his disposal to do his work well. No preparation was made for properly publishing his results. Discouragements dogged his footsteps. Every farmer claimed the right to have his own farm surveyed completely first. No idea of the real nobility, the true utility, the enormous difficulty of the enterprise was entertained even by the intelligent of society. What did the *hoi polloi* think of it? They alternately jeered and vituperated. Every year a new Legislature renewed the discussion whether or not there was such a science as geology; whether or not people needed maps; whether or not a government had any business with finding out the mineral value of its own territory; whether or not to individuals could not be safely left the task of informing each other on such points; and whether or not the revenue of a great State could bear the drain of the salary of a geologist and his corps of assistants.

Speculators in lands and mines hated a government survey, because it interfered with and forestalled their speculations. Miners hated a State survey, for they knew its natural effect to be to restrain the waste of the precious minerals belonging to the commonwealth and to future generations. Politicians hated a State survey because it set a bad example, by constituting a kind of office which was not manageable with wires, paid no bonus for bills passed, and established an irresponsible precedent of honest work and economical utility.

One by one the State surveys on this side of the Atlantic were stopped. When the civil war came not a single survey could be said to have a real existence. Publications of the old surveys had been so meager that scarcely any record of all the work done could be found. There is but a single complete copy known of the reports of the State geologist of Virginia, and that is not at Richmond, but in the private office of Major Hotchkiss, in Stanton. I do not know of a single complete copy of the seven

annual reports of the State geologist of Pennsylvania. The reports of Lieber, Tuomey, Task, Percival, Hitchcock, and Jackson are exceedingly hard to obtain. Nor has any good compendium of the facts contained in these reports, meager as they were, been given to the public.

After the war, the western States woke up to the necessity for State surveys, and the State geologists of Illinois, California, Ohio, New Jersey and New Hampshire have been publishing noble volumes, illustrated with wood-cuts and maps. Tennessee has published a volume; Indiana one; and smaller reports have been made in three or four other States. Kentucky has just granted a small subsidy for re-opening its survey.

At last the United States government was made aware that its vast territorial possessions must be explored. Western men clamored at the doors of Congress. Dr. Hayden had aroused a genuine enthusiasm for geological knowledge in the interior by his personal publication of his own unaided explorations. The geological survey of the territories under the auspices of the Secretary of the Interior was commenced. Dr. Hayden has received larger and larger appropriations each successive year. Clarence King has had a large amount of government money placed at his disposal. At last, publications on a scale worthy of so great an empire are at the command of students, and of business men. The work will never stop; of that you may be well assured. It is of a nature so imperative, and its nature has been so clearly demonstrated to the satisfaction of our western population, that no British survey, no Austrian survey, will surpass the survey of its territories by the United States government in the course of the coming twenty or thirty years. As it goes on it will become more local, more precise, more exact in its details, more full in its illustrations, and always more rich in its consequences.

What has been doing ever since 1837 on the British side of the St. Lawrence and the St. Johns, that great provincial government geological survey of Canada under Sir W. E. Logan, of which I have not spoken; a survey now directed by Mr. Selwyn, with a large corps of assistants, in Upper Canada, Labrador, New Brunswick, Nova Scotia, Cape Breton and Newfoundland, with a splendid museum at Montreal, and one of the finest geological maps ever made—just that is destined to go on for the next gene-

ration in all the country west of Kansas and Minnesota, and on a grander scale.

But, gentlemen, poor Pennsylvania, meanwhile,—poor Pennsylvania is left out in the cold; nay, insists on standing out in the cold. With all these great fires burning in Europe and America, in full view,—with elaborate and costly surveys of the highest utility prosecuted year after year with steadiness and ever increasing facility, even by governments as democratic as that of Switzerland, and of lands, like those of the Swiss cantons, almost totally destitute of coal, iron, gold, and the other more valuable minerals—Pennsylvania, in her own estimation the richest of all States in mineral wealth—Pennsylvania refuses, year after year refuses, point blank, to take any share in this stage of the world's progress. She says: she is too poor to make a geological survey of her counties. She says: it is not of much consequence anyhow. She says: her position is so well established in the society of Christian States, that she can dress in old clothes if she pleases. She says, that if the people of Bucks or Adams or Venango county want their land surveyed, let them do it for themselves; if iron men want iron veins let them find them; if oil men want to know how long the "over-production" is to last, let them find out; if architects and engineers want to know where the most lasting building stones are, let them hire their own experts to get the information; and if a farmer be enlightened enough to wish to know something of how the world is built beneath his fields, let him be patient; no doubt his children or grandchildren will discover it.

The oldest geological survey on record was found in the tomb of an Egyptian mining engineer, of the age of Seti I., the predecessor of Sesostris Rameses Meiamoun, 1st Pharaoh of the XIXth dynasty, 1500 years B. C. It is a colored map of the Nubian gold mines, 21 inches long, preserved among the precious archives of the Turin Museum; has been published and described by Lepsius, Birch, Chabas and Lauth, and may be studied in a paper of the *Sitzungsberichte* of the Munich Academy for 1870. Streets, houses, smelting works, shafts, canals, and surrounding hills are portrayed upon this curious relic of the practical science of an age previous to the dawn of Greek and Etruscan history. The objects

designated are all named as upon modern maps; and we read among the legends that "the hills from which they get the gold are colored on this plan red." One of the streets has the legend "this leads down to the river Juma." In the middle reads "a monument to king Raenma (Seti I)."

Geological surveys are but the modern differentiation of the more ancient geographical surveys of the earth's surface. The earliest of these, well known to us, is that planned by Julius Cæsar, ordered by Augustus, finished after twenty years of work under Tiberius, and described by Pliny in his XXXVIIth book; where he says: "As for myself, I think that the measurement of these countries is not always very certain." We may say the same of our modern geological surveys; but with what a tremendous difference in the force of the expression in the two cases! There is nothing like absolute perfection, complete certainty, in any part of human knowledge outside of mathematics. But a glory of our age is the rapid approximation we are making to that ideal perfection which is both the goad and goal of human effort.

Long before Cæsar's time geography was followed as a pastime, a science, or a business. Our earliest prehistoric hints of the geography of the old world are in the orphic poems. Then come the descriptions of Herodotus, of Aristæas, who seems to have traveled as far as the gold mines of the Oural mountains; of Ctesias, the physician of Artaxerxes; of Hippocrates, of Democritus of Abdera, 445 B. C.; of Hecateus the Miletian, and Hellanicus of Mytilene, (504 B. C.) of Hippys of Rhegium, and Anaxagoras the teacher of Euripides; of Plato and Aristotle (429 and 368); of Antiochus of Syracuse (350); Scymnus of Chios (373); Scylax, the describer of the circumnavigation of Africa by the Carthaginian Hanno (390-360); of Pytheas of Marseilles, who in 360 B. C. sailed along the coasts of France into the Baltic; of Hipparchus of Nicæa (128), Agatarchides (120), Posidonius and Eudoxus (96), Metrodorus, Pliny, Strabo, Ptolemy and Tacitus, and a crowd of smaller names.

The object of Cæsar's survey was worthy of the practical and intellectual genius of that wonderful man. But what appeared on the surface of it to his contemporaries was only the determination of the geographical limits of the Roman empire. In the mind of Octavius Augustus the work was narrowed down to taking a cen-

sus of the nations for fixing the fiscal income of the court. Such, no doubt, were the views of David, King of Israel, in view of the extraordinary expenses of his projected temple. Such was probably the dominant motive of the Pharaohs, centuries still earlier. Such has been the standing motive for such State surveys in all ages and countries governed by an autocrat, an oligarchy, or a priesthood.

A wiser spirit rules the modern world. Autocracy, oligarchy, and aristocracy, temporal and spiritual alike, have received their death blows. We are now all democrats. Princes talk democrat. Science is the pure spirit of democracy; it knows no distinction of persons; it is the very thought of God the Common Father, who makes his sun to shine, his rain fall, his grain grow, his coal burn, his gold shine, for the evil and for the good.

A geological survey, if not pursued on democratic principles, must be a failure. Its utility is an outcrop of the great underground benefaction of the God of metals and of soils. It is meant to teach all—every farmer, every citizen, what and where are his stuffs of livelihood. To confine it to the learned would be to reproduce the obsolete absurdity of sacerdotal and baronial times.

Let me develop this idea by homely personal illustration, out of my own experience in business life.

I have received large fees for professional reports on special properties in Pennsylvania and elsewhere. To make these reports I was obliged to call to my aid all the resources of modern science, and the observation and reflection of a life spent in the field, at the drawing board, and in the library. I was compelled to survey with instruments and map on paper, and sometimes model in clay, the district to be reported on. I had also to study the surrounding country, and compare all with still more distant localities. Every surface indication must be noticed; every hole explored; old openings re-opened; new ones made; specimens analyzed, and the practical working of mineral from the same beds elsewhere found out by inquiry at iron works and other centers of activity.

All this cost previous education, time, hard work, exposure, hire of hands, traveling expenses, instruments, chemicals, sleepless nights and waste of brains. Hence the high fees.

My employers were either large capitalists or bold speculators.

Sometimes I was paid, sometimes I was not. It was never anything to me whether my employers made money or not. That was their affair, not mine. My only concern was to learn the truth that I was paid to tell; if that truth were agreeable or disagreeable to my employers was nothing to me. Some of them wished to buy; some to sell; some to raise additional funds for honest mining operations. All sorts of practical questions were to be answered: the cost of labor; the way of approach; the kind of machinery; the mode of exploitation under ground; the best use in the arts of the special quality of mineral. But underneath all these questions, and preliminary to their answer, was always a truthful, hardly worked out and carefully portrayed geological survey of the property. Many of these practical questions I relegated to experts who were not geologists. I busied myself chiefly in making a faithful geological survey. When that was done there were plenty of good practical heads who could work out the practical problems from my data as well as, or better than myself. But they could not get the *data*; I had to do that myself.

And now this is precisely what a State geological survey does for the whole of society; it gives the data. Practical men of all kinds can then work out the practical problems for themselves. But until they get the data they cannot. They are all in the dark about the prime facts. When these are obtained by the State geologist, the miner can easily tell how to open and work his bed; the civil engineer, how to lay his line; the mechanical engineer, what works to put up; the railway superintendent, how much rolling stock to provide; the capitalist, how much money to invest; the iron man, where to look for the ores he needs; the farmer, what chance he has for a market.

Everybody is interested in *having the first facts*. That is what a State Survey gets and makes public. That makes its MATERIAL utility to a commonwealth. It tells facts, and it dissipates errors. In fact, it does more good in preventing capital from being badly invested, than in drawing capital to safe investments. It does as much for farmers who dream that they have gold, or coal, or magnetic iron, or zinc, in their lands, when they have not, as for farmers who have such riches concealed beneath the sod and do not know it. It saves the commonwealth from throwing away

millions of money, and many an unhappy enthusiast from ruin.

But this is not what many desire. The power of the few is enhanced by a monopoly of knowledge. The largest part of my geological life is hid away in reports to employers who have never published them, nor wished them to be published. To have made known facts thus obtained and placed in true relationship with the speculations of the business world, would have interfered with plans and prospects, to the realization of which a certain class of people dedicate their lives. To disseminate accurate geological knowledge among farmers and small land owners naturally enhances the value of farms and warrants, and enables their owners to make better terms with those who mean to buy and sell speculatively. To publish the exceptional value of one range of minerals, and the inferior value of another, redounds to the economy of society at large, but it jeopardises the existence, or at least the pecuniary success, of incorporated companies formed on insufficient bases.

To my mind this is precisely one of the loudest calls which the people at large make upon their legislators. It is precisely that which makes a State Survey so radically democratic.

Let me offer for your consideration now another train of thought.

The public utility of a government geological survey can rather be felt than described, because the relation of its special utilities would be tedious, while its intellectual influence in informing the general mind, and in training professional experts for the future service of the commonwealth, belongs to that system of common education which justifies itself with difficulty before the every day working world.

It is none the less true, for this, that a State geological survey is a practical school of superior order and of the highest usefulness to society. It manufactures slowly and surely the best experts—men of original research. Book-learning, the old fashioned didactic instruction in colleges, never made a geologist or mining engineer. Even the improved curriculum of polytechnic institutes and schools of mines can merely prepare a young man to take the field, where his own close study of nature must fit him for the service of society. The State alone can furnish such a postgraduate course for those who are to be the servants of the State in a peculiar sense.

I must hurry over another branch of the subject which would interest you. A geological survey is a gymnasium of the highest style of art, perpetually leading back to absolute fidelity to nature a certain number of representative artists, who by their position and vocation must needs exercise a powerful influence upon the art sentiment of their age.

I think I have covered the ground at your request. A volume might be written in illustration of the truths I have this evening sketched or hinted at. But you will not be dissatisfied, if I allude to that strange anomaly—Pennsylvania holding the centennial celebration of national progress in the tillage of the soil, the exploration of the mines, and the conversion of minerals into tools and objects of art without herself having a geological survey in progress.

That is an odd circumstance, is it not? The Government of the United States invites all nations to dine with her in the house of one of her children at a time when that child has no cook in her own kitchen. And Pennsylvania expects the State geologists of other parts of the Union to expose their systematic museums of minerals and metals in her own memorial hall of 1874, and at the same time begs to be excused from doing the same herself, because she is too poor to have a geological corps of her own to organize her own museum.

Gentlemen, we are all Pennsylvanians. I myself was born within a gun-shot of this house. I shall be mortified, and you will be, if this absurd state of things continues until it be too late to obviate its natural consequences. But I fear something still more mortifying. I fear that our assembly will take inadequate action on it this winter. The men at Harrisburg have no conception what a good geological survey of this State should cost. They will be likely to appropriate enough money to survey a couple of counties, and then demand that it shall suffice for the survey of the entire State. Or they will appropriate money for the mere haphazard collection of Pennsylvania minerals for the exhibition of 1874, and overlook those considerations of utility which, as I have said, weigh with all other enlightened governments except our own.

Let us have a State geological survey, whether the Centennial be creditable to Pennsylvania or not. Let that survey be well

ordered and sure, permanent and perpetual; a training school of public servants, genuine geologists, mining engineers and metallurgists; an apparatus of discovery; a conservator of economy; a publisher of real data for all the people; a disperser of errors; a recorder of knowledge got which would otherwise perish; and, in one word, be the geological brain of the State, giving a heathful reality to all those movements of our business world which have to do with the mineral world.

The considerations which I have urged will weigh against the objection that there has already been a geological survey of Pennsylvania, under the direction of an able man, assisted by a large and efficient corps, resulting in the publication of a great report, with many hundred pictures, sections, tables and maps, including a map of the State.

True; but it is none the less a necessity for Pennsylvania to continue to have a geological survey.

Besides, the old survey was little better than a magnificent sketch; a foretaste of what could be done; the groundwork of future explorations.

One-half of the State can be truly said not to have been surveyed. It was a forest thirty years ago; now it is well settled. Then it had no roads; now it is crossbarred with railroads. Bituminous coal was then worthless; now it is of priceless value. Small cold blast charcoal furnaces then made enough iron for the country's consumption; now, highstack hotblast, coke and anthracite furnaces clamor for ore.

Besides that, the whole outcrop of our fossil ore is to be studied.

Besides that, the Adams and York county ore region has come into market and was never surveyed. The geology of the gold, chrome and serpentine region south of the Chester Valley is almost wholly unknown.

Besides that, petroleum was not thought of until long after the old survey was stopped.

And to finish with but one more of many arguments for the utility of fresh surveys—not one of our hundred counties has a geologically colored map. We need a new survey if for no other reason to provide all the people of Pennsylvania with a small, cheap, handy atlas, in which each county shall be accurately colored to show its mineral resources. Mark, I say *accurately*. No

slipshod, perfunctory, penny-wise, pound-foolish deception of a map—but something that will bear the test of wear and tear in a thousand hands, deceive nobody, enlighten everybody, especially our growing boys; one accomplished with all that outlay of wealth, work, time and science which perfection in such a thing demands





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